Improving Adolescent Parent-Infant Interactions: A Pilot Study

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The study objective was to pilot test Keys to Caregiving, a program designed to improve interactions and contingent responsiveness between adolescent mothers and their infants. First-time adolescent parents, aged 15 to 19 years, received either the Keys to Caregiving program delivered by 6-weekly visits or a control program consisting of 6-weekly neutral visits. Parent-infant interactions and contingent responsiveness during teaching and feeding, and infant cognitive development were assessed when infants completed the program. The results suggest that the Keys to Caregiving program shows promise as a method of improving adolescent mothers' interactions with their infants.

SENSITIVE AND RESPONSIVE parenting is a challenge for any parent; for the still developing adolescent it may be even more so. Compared with older mothers, adolescent mothers' interactions with their infants have been characterized as being less sensitive to infant cues, more unrealistic about expectations of infant behavior, less verbal and responsive toward their infants, more impatient, and more prone to use physical punishment (Barnard, 1997; Coley & Chase-Lansdale, 1998; Ruff, 1987; von Windeguth & Urbano, 1989). These behaviors place the children of adolescents at risk for less than optimal development (Maynard, 1997; Wakschlag & Hans, 1999). In contrast, children reared in environments characterized by high-quality, parent-infant interactions are likely to demonstrate successful developmental outcomes such as readiness for school, social skills, peer competence, and cognitive ability (Sumner & Spietz, 1995a; Werner & Smith, 1992; for a review see Letourneau, 1997).

High-quality, parent-infant interactions are characterized by mutual warmth, sensitivity, and responsiveness (Barnard et al., 1989). For high-quality interactions, infants must send clear cues about their needs and wants whereas parents must be sensitive and able to respond to infants' needs. When these social interactions are mutual, they are referred to as being *contingently responsive:* the behavior of one evokes the appropriate response of the other. An example of a contingently responsive parent-infant interaction is demonstrated by a parent speaking followed by the child turning to listen or vice versa (Barnard, 1997). Contingent actions and reactions by parents and infants characterize optimal interactions that also favor children's successful development (Sumner & Spietz, 1994a; Tarabulsky, Tessier, & Kappas, 1996). All interactions need not be contingent, however, it is rather the overall proportion of contingently responsive interactions that favors children's development (Chamberlain & Patterson, 1995).

Infants reared by parents in stressful circumstances or with little knowledge of parenting or infant development may not experience optimal interactions. Parents lacking education or experience, such as adolescent parents, are particularly at risk for less than optimal parent-infant interactions (Censullo, 1994; Irvine, Bradley, Cupples, & Boohan, 1997; Porter, 1990). Examples that characterize less than optimal parent-infant interactions include a parent's lack of affection or attentiveness or a child's tendency to overstimulation.

Adolescent parents stand to benefit from intervention that improves parent-infant interactions. Adolescent parents are more likely than older mothers to abandon further education and to live in poverty (Brooks-Gunn & Chase-Lansdale, 1995; Hayes, 1987; Wilkins, Sherman, & Best, 1991); both factors contribute to stresses that may nega-

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tively influence the quality of parent-infant interaction (Sumner & Spietz, 1994a, 1994b). In addition, the adolescents' stage of development (Trad, 1995; Yoos, 1987) combined with the risk of experiencing postpartum depression (Beck, 1995) may lessen their emotional availability to their infants, with potential negative impacts on parent-infant interactions. It is not surprising, given these risk factors, that offspring of adolescents are prone to less than optimal outcomes.

The quality of contingent responsiveness in parent-infant interactions is linked to cognitive development in children (Beckwith & Cohen, 1989; Beckwith, Rodning, & Cohen, 1992; Bornstein & Tamis-LeMonda, 1989; Coates & Lewis, 1984; Dunham, Dunham, Hurshman, & Alexander, 1989; Lewis & Coates, 1980). However, only two studies are identified that examine the relationship between contingent responsiveness and the development of infant expectations, as an aspect of infant cognition (Lewis & Goldberg, 1969; Hains & Muir, 1996). Contingently responsive social interactions may enable infants to develop expectations that their behavior is effective (Lewis & Goldberg, 1969). As an example, consistent turn-taking between a parent and infant in conversations and activities fosters the development of the infant's ability to predict events. These expectations motivate exploration, learning, and the practice of new skills that contribute to cognitive development (Goldberg, 1977). Both Barnard et al. (1989) and Haith (1993) suggest that these relationships have not been sufficiently investigated.

The Barnard Model provides the underlying theoretical framework for this study in its explication of the interplay between caregiver/parent and infant characteristics in interactions that favor children's successful development (Sumner & Spietz, 1994a, 1994b). Barnard's Model indicates, for example, that parents need to be sensitive to infant cues and alleviate infant distress, whereas infants must give clear cues and respond to their parent for optimal interactions to take place. This author poses a refinement of the model that focuses on the examination of the relationship between parent-infant contingency in interactions, the infant's subsequent ability to form expectations, and infant cognition. Other variables, such as the infant's developing social competency may also be examined with the refined model; however, this is beyond the scope of the pilot study (Letourneau & Drummond, 2000; Figure 1).

Nursing intervention programs have been developed to promote sensitive and contingently responsive parent-infant interactions; however, few programs have been extensively tested before use in practice. Because of the special risks associated with adolescent parenting, rigorous testing of such interventions is imperative. Therefore, the research question asks, "What is the effect of a nursing intervention program designed to improve the quality of interaction and contingent responsiveness between adolescent mothers and infants on (1) parent-infant interaction, (2) contingent responsiveness within parent-infant interactions, (3) infant cognitive development, and (4) infant expectations as an aspect of cognitive development?" It is hypothesized that the intervention program will improve parent-infant interactions and contingent responsiveness, and enhance infant cognitive development and expectations.

METHODS

Sample

Forty-nine eligible adolescents were approached within the first week postpartum to participate in this study. They were deemed eligible if they were aged 13 to 19 years, first-time inexperienced primary caregivers, having an uneventful postpartum

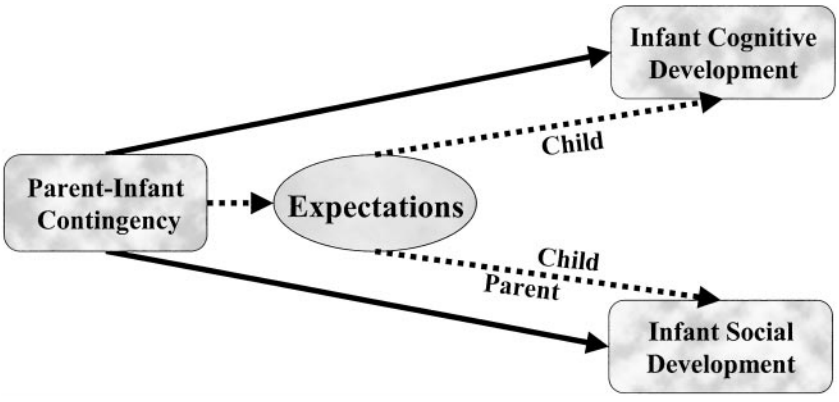

Figure 1. Parent-infant contingency and expectancy model.

recovery, not known to have abused alcohol or drugs during pregnancy, able to read and write English, and residents of a large western Canadian city or surrounding area. Eligible infants were healthy singleton births of at least 35 weeks gestation, weighing at least 2,500 grams at birth, and all but one were discharged into mothers' care within 3 days of birth. One infant experienced benign heart arrythmias and oxygen desaturations in the 24 hours after birth and was kept for observation until discharged after 8 days. No subsequent problems arose with this infant.

Procedures

Ethical approval and permission to conduct the study were obtained from the appropriate institutions before commencing recruitment and data collection. Adolescent mothers who met the selection criteria were approached either in the hospital before discharge or by telephone shortly after discharge. Potential participants were told that the purpose of the study was to assess two programs designed to aid parenting and to promote infant development and health. They were also told that they would receive six home visits from a registered nurse. It was explained to participants that the specific differences between the two programs could not be revealed until the end of the study to prevent bias. Informed consent was obtained.

Twenty-four mothers, aged 15 to 19 years, agreed to participate. All discussions with participants about the details of the study took place before random assignment to groups. This created a partial blind (Christensen, 1994), hence, expectations about study results could not be conveyed differentially to the intervention and control group participants.

Participants were randomly assigned to either the intervention ($n = 13$) or the control ($n = 11$) group based on a random assignment schedule that had been developed before the commencement of the study. Small sealed envelopes, each containing an assignment to a group, were randomly matched with a case number. Once the sealed envelope was opened, a nurse-interventionist initiated plans for the assigned group. The master's prepared nurse-interventionist, who underwent 12 hours of training and study in the provision of the intervention program, followed a detailed protocol manual for the duration of the program. The same nurse provided both the control and the intervention programs.

Mother-infant pairs from both groups were visited weekly for approximately 1 hour to provide the intervention or to receive a neutral visit. There were six weekly visits that took place when the infant was younger than 1 week to 6 weeks old. The infants visited the perinatal clinical laboratory twice for assessment after the program, when they were aged 7 to 9 weeks and 11 to 13 weeks.

Design and variables. A 2×2 mixed model factorial posttest only design was used for this study. Pretesting was believed to be unfeasible as it was likely to threaten participation of the already burdened newly postpartum mothers. Because of the small sample size, repeated posttest measurement was conducted to increase the stastistical power to detect differences. The two independent variables were group (intervention, control) and age (7 to 9 weeks, 11 to 13 weeks). The between-groups variable was group and the within-groups variable was age. The primary outcome variables were parent-infant interactions during teaching and feeding, contingent responsiveness, infant cognitive development, and infant expectations.

Intervention group. The Keys to Caregiving program was used to teach parent-infant interactions and to promote contingent responsiveness (NCAST, 1990). The intervention began once the participants were discharged. One topic from Keys to Caregiving was presented each week for approximately 1 hour: infant states, week 1; infant behaviors, week 2; infant cues, week 3; state modulation, week 4; and feeding interaction, week 5. Participants were provided with the appropriate Keys to Caregiving information pamphlet before each home visit. A final visit was made between weeks 5 and 6 of the study to reinforce and review the Keys to Caregiving materials. During home visits, the concepts in the pamphlets and how they applied to the participant's new infant were discussed. Participants were encouraged to relate examples of the behaviors discussed to their everyday understanding of their own infants. A brief video was shown of infants exhibiting the same and different behaviors than were observed in the participant's new infant. As participants proceeded through the intervention program and continued to build on their knowledge, they learned when and how to interact with their infants in contingently responsive ways to promote optimal development.

Flexibility was built in to the program to meet individual needs. If the participant asked about a topic to be presented later on, the nurse interventionist was permitted to leap ahead in the program, in the form of incidental teaching. When this occurred, the topic also was covered during the week

it was scheduled. As a result, incidental teaching relating to a program topic was reinforced at the regularly scheduled time, and incidental teaching about basic infant care or postpartum concerns occurred as needed. Incidental teaching and notes about discussions between the nurse and parent that occurred during each visit were documented.

Control group. Participants were treated identically to the intervention group except that they did not receive the parent-infant interaction intervention program. They were visited for approximately 1 hour per week by a nurse on the same schedule as the intervention group, with the objective of providing support. There was no preplanned discussion about parent-infant interactions or contingent responsiveness. Only incidental teaching about basic infant care or postpartum concerns occurred in response to remarks made by participants during the visit. This strategy controlled for potential confounding effects associated with receiving a visit from a nurse, because both groups received a visit and only the content of the visit differed. After each visit, events that occurred were documented. Participants experienced an abbreviated form of the parent-infant interaction intervention at the end of the 3-month study.

Data Collection

Measures of socioeconomic status, postpartum depression, and difficulty of life circumstances were obtained to identify potential confounds to the study. Whenever necessary, participants received assistance to complete questionnaires.

Demographic data. Demographic information was collected by chart review and informal interviewing as part of scheduled home visits. The Hollingshead (1965) Four-factor index of participants' socioeconomic status was calculated for all participants. Potential scores range from 8 to 66 with lower scores associated with more socioeconomic disadvantage.

Edinburgh postnatal depression scale (EPDS). The EPDS is a short, structured, self-report measure (Cox, Holden, & Sagovsky, 1987). The scale has 10 items, with a possible range of scores from 0 to 30, with higher scores indicating more symptoms. A score of 12 or more indicates depressive symptoms. The questionnaire was administered at both data collection times (7 to 9 weeks and 11 to 13 weeks).

Difficult life circumstances scale (DLC). The DLC is a 28-item binary scale that assesses the existence of stressors or chronic problems in families that may affect the quality of parent-infant interaction (Barnard, 1989). A score of 6 or more is associated with less than optimal child developmental outcomes. The questionnaire was administered at entry to the study.

Nursing child assessment feeding (NCAFS) and teaching (NCATS) scales. The NCAFS and NCATS (Sumner & Spietz, 1994a, 1994b) are the most widely used observational measures of parent-infant interactions and may be used to assess the contingent responsiveness of parents and infants to one another. These binary scales provide two conceptually parallel descriptions of social interaction between parents and infants, effectively increasing the generality of the observations across settings and providing a more comprehensive picture than when these scales are used alone. The scales allow for the examination of the total (overall) interaction, and subscales examine the parent and child contributions, and the degree of contingent responsiveness in the interaction.

Both scales have been normed on a large sample of children and are suitable for administration to children younger than 1 year (Sumner & Spietz, 1994a, 1994b). It has been repeatedly demonstrated that the measures are predictive of later relationships and behavior related to successful outcomes in children (Barnard, 1995). The normed means and standard deviations of the NCAFS and NCATS database are available on a comparable sample of adolescents. Also, 10th percentile cutoff scores, indicative of clinically relevant or worrisome interactions are reported in the literature and may be calculated from the large NCAFS and NCATS datasets (Sumner & Spietz, 1994a, 1994b). Table 6 presents these data as well as the maximum possible scores attainable on the scales and relevant subscales.

Mothers and babies were videotaped in a laboratory setting during feeding and teaching interactions at 7 to 9 weeks postpartum and again at 11 to 13 weeks postpartum. A certified instructor taught one data coder, blind to participants' group assignments, to score the tapes according to the NCAFS and NCATS protocols.

Before coding the dependent variables of NCAFS and NCATS, the data coder achieved interrater reliability of greater than or equal to 90% with videotapes previously scored by the University of Washington, Nursing Child Assessment Satellite Training (NCAST) program. As a check on intrarater reliability, a random numbers table was used to select 6 of the 31 NCAFS and 6 of the 31 NCATS for rescoring. The mean intrarater reliability was 95.3% (range = 90% to 99%) for the

NCAFS, and 94.0% (range = 90% to 97%) for the NCATS.

Visual expectation paradigm test (VEXP). The VEXP measures the development of infant expectations, as an aspect of cognition (Haith, Hazan, & Goodman, 1988). The test involves structured observations of infants' eye movements. It was administered to the infants in the laboratory setting at 11 to 13 weeks old. The VEXP shows promising reliability and validity, as compared with other measures of infant cognition (e.g., the Gessell Developmental Schedules, the Bayley mental development index, the Catell Infant Intelligence Scale) (Bensen, Cherny, Haith, & Fulker, 1993; DiLalla et al., 1990; Dougherty & Haith, 1997; Haith & McCarty, 1990).

A simplified method of conducting the VEXP was developed and tested in the pilot study because of the expense of the conventional technique. Essentially, modifications involved the use of videotape technology. Although Haith and colleagues measured and recorded the center of the infants' pupils from frame to frame with computer technology, the simplified technique used observers' judgements to identify infants' eye movements. The principal investigator learned to administer the test through consultation with the test originators, and then trained two coders to code the data in partial blind assessments.

The VEXP was initiated when the infant was in an alert and nonfussy state. The test was administered to the infant reclining in an infant seat directly in front of and facing a television. A screen was placed around the infant to ensure that attention remained on the television and not other environmental stimuli. A video camera was positioned above the television screen and directed so that the infant's eye movements could be recorded.

A video was shown on the television located in front of the infant. The video presentation consisted of colorful, graphically designed stimuli, that moved up and down to attract the infant's attention as each stimuli appeared to the right or left of center. Each stimulus appeared for approximately 700 ms, followed by an approximately 1000 ms interstimulus interval in which the screen was black. After the baseline, consisting of 11 random presentations of stimuli, 80 more visual stimuli appeared in a specified order during the test phase (Benson, Cherny, Haith, & Fulker, 1993; Jacobson et al., 1992). The infant's visual reactions to and anticipations of movement of the stimuli were filmed with a video camera and recorded on videotape during the 3-minute test. For coding purposes, audio signals that corresponded exactly with the presentation of each stimuli, but were inaudible to the infants, were recorded on the same videotape.

Reaction time was calculated, using video editing equipment, from the time of the stimulus onset until the time of eye movement. It has been reported that 200 ms is the minimum amount of time in which the human eye can respond to stimuli (Columbo, 1993). During the test phase, if eye movement shifts from one side to the other before stimulus onset or 200 ms after stimulus onset, it can be stated that the infant anticipated or expected the appearance of the stimuli. Faster reaction times or a higher proportion of anticipations may reflect the infant's learning of a spatiotemporal rule (DiLalla et al., 1990). Results were tabulated to reflect the postbaseline median reaction times (RTs) percentage of anticipations ($\leq$200 ms), and percentage of fast RTs (201 to 301 ms).

The VEXP data were examined for reliability before analysis. As the VEXP technique was modified, measures of both interrater and intrarater reliability were tabulated. One data coder scored all 15 videotapes, then a random numbers table was used to select 5 tapes for recoding. Three tapes were scored for interrater reliability by a second data coder. Data coders agreed 47% of the time about whether an anticipation or reaction occurred in response to a stimuli event identified by one or the other as having a response. In cases of agreement, data coders' mean difference in their recordings of RT was half a frame or approximately 17 ms (M = 0.52, SD = 12.28). The remaining two tapes were scored for intrarater reliability, and the lone data coder achieved 61% agreement about whether or not an anticipation or reaction occurred to stimuli events in both scorings. In cases of agreement, the lone data coder's mean difference in recording of RT was nearly three frames (M = 2.70, SD = 10.56).

Bayley scales of infant development II mental development index (MDI). The MDI (Bayley, 1993), as a general measure of infant cognition, provided cognitive development quotient (DQ) scores. The test complemented and served as a comparison with the more specific VEXP measure of infant expectations, as an aspect of cognition. Considered to be the standard for evaluating general developmental functioning of infants and young children in the cognitive domain, the MDI reflects current norms. The MDI has been recently updated and improved over the previous edition of the Bayley Scales. The test items largely rely on

the sensorimotor development of infants in the assessment of cognitive capacity. Much like conventional intelligence quotient tests, the MDI is normed so that 100 is the mean performance and 15 is the standard deviation. At 3 months of age, infants must be observed to complete five or more items in an item set, beginning with the 3 month items. The MDI was administered in the laboratory by the investigator who had established reliability. This was done at the second assessment interval, when infants were aged 11 to 13 weeks.

Since the investigator who conducted the DQ tests was aware of participants' group assignments, the test sessions were videotaped to enable an independent, reliable data coder to view 20% of the tapes to provide a measure of interrater reliability. The data coder, blind to participants' group assignment, used a random numbers table to select three videotaped sessions for rescoring. The data coder achieved 100% agreement with the investigator on all three MDIs.

Data Analysis

Hollingshead SES, DLC, and EPDS scores were calculated for each participant. For all of the demographic data, equivalency of study groups was assessed with independent samples *t*-tests, after ascertaining that none of the independent variables were significantly skewed according to Fisher's test for skewness and that variances were equal according to Levene's Test for Equality of Variance.

Fisher's tests and appropriate heterogeneity of variances tests (either Levene's, Bartlett-Box, or Box's M Tests) were also conducted on the dependent variables: total, parent, child, and contingency scores on the NCAFS and NCATS at each time point, MDI scores, and the VEXP data reduced to measure postbaseline median RTs, Percentage of anticipations, and percentage of fast RTs. The dependent variables were examined with independent samples *t*-tests, confidence intervals, and effect sizes (using the conservative pooled standard deviation term; Rudy & Kerr, 1991), 2-way analysis of variance procedures (ANOVA), or Wilcoxin-Mann-Whitney tests as appropriate. The error rate (α) for falsely rejecting the null hypothesis of no difference between groups was set at 0.05. One-tailed *t*-tests were adopted as intervention was predicted to facilitate development.

Table 1. Timing of Administration of Instruments or Tests

	Preintervention	7-9 Weeks	11-13 Weeks
EPDS		√	√
DLC	√		
NCAFS & NCATS		√	√
VEXP			√
MDI			√

Note. EPDS, Edinburgh Postnatal Depression Scale; DLC, Difficult Life Circumstances Scale; NCAFS, Nursing Child Assessment Feeding Scale; NCATS, Nursing Child Assessment Teaching Scale; VEXP, Visual Expectation Paradigm Test; MDI, Mental Development Index.

RESULTS

Participant Characteristics

Of the 24 mothers who agreed to participate, 5 dropped out before the visits were completed; 1 dropped out after the six visits but before the assessment sessions; and 18 completed all visits and one or two follow-up visits. Infants were aged 7 to 9 weeks and 11 to 13 weeks at the follow-up visits. Of the 6 who dropped out, two families moved away, 2 were unable to make the time for home visits, 1 family's infant became ill and was admitted to hospital for an extended period of time, and 1 mother cited difficulty coping with the demands of motherhood in addition to being involved in the study.

While 18 participants completed all of the home visits and one of the two follow-up visits for assessment, only 15 completed the first follow-up visit at 7 to 9 weeks (7 intervention, 8 control) and 16 completed the second follow-up visit at 11 to 13 weeks (8 intervention, 8 control). Of the 16 who completed the second follow-up visit, 1 control group infant was unable to complete the MDI and VEXP testing. In all, 13 mothers and infants completed all of the visits (7 intervention, 6 control). Chi-Square Phi tests showed that participants who were unable to complete the follow-up visits were more likely than those who did to have their infant admitted to the NICU ($\phi = .500$, $p = .034$), experienced difficulties with a partner or spouse ($\phi = .614$, $p = .009$), and to be in the control group ($\phi = .553$, $p = .019$) (Letourneau, 2000). Thirteen participants (6 control, 7 intervention) completed all of the home visits and both the follow-up NCAFS and NCATS assessments.

Demographic data are reported in Table 2. All participants reported being the major caregiver for their infants. No significant differences were found with respect to infants' sex, gestational age, infants' birth weights, mothers' years of schooling, EPDS scores, Hollingshead SES scores, or DLC scores on independent samples *t*-tests for equivalency of groups. In addition, it was shown by the variance covariance matrix that no significant co-

Table 2. Demographic Data

Variable	*M*	Median	Range	*n*
Age at birth	18.06 (1.01)	18.20	15.96-19.79	18
Years of education	10.11 (1.32)	10.50	8.00-12.00	18
Hollingshead SES	25.97 (7.56)	27.50	15.50-36.50	18
DLC	2.50 (2.18)	2.00	0-6.00	18
EPDS at 7-9 weeks	7.07 (4.15)	7.00	1.00-14.00	15
EPDS at 11-13 weeks	6.69 (4.35)	5.00	1.00-14.00	16
Weeks gestation	39.36 (1.05)	39.40	37.50-41.30	18
Birth weight (grams)	3221 (383)	3273	2590-3960	18

Note. Standard deviations in parentheses. SES, Socioeconomic status; DLC, Difficult Life Circumstances Scale; EPDS, Edinburgh Postnatal Depression Scale.

variances existed between the demographic variables and the dependent variables, implying that the study findings were likely not confounded by any of the measured variables.

Parent-Infant Interaction and Contingent Responsiveness

Two-way ANOVAs were computed by using the data from only those participants who completed all measures of NCAFS and NCATS. Separate analyses were done for total and subscale scores. For the NCAFS, significant group main effects included the total scores ($F = 4.59$, $p = .028$, $n = 13$), Parent subscale scores (although the assumption of homogeneity of variance was violated, $F = 10.2$, $p = .004$, $n = 13$), and Contingency subscale scores ($F = 6.21$, $p = .015$, $n = 13$). For the NCATS, significant group main effects included the total scores ($F = 4.66$, $p = .027$, $n = 13$), Parent subscale scores ($F = 3.95$, $p = .036$, $n = 13$), and Contingency subscale scores ($F = 3.59$, $p = .043$, $n = 13$). Neither age nor group by age effects were significant in any comparisons. Mean scores are reported in Tables 3 and 4.

Separate independent samples *t*-tests were also computed for each data collection session and dependent variable. This approach was taken to analyze all data available at any session (participants at the two sessions differed because of dropouts and incomplete data). Effect sizes were also tabulated for significant findings. The *t*-tests showed significant differences between the intervention and control groups on two of four parent-infant interaction total scores, three of four Parent subscale scores, and one of four Child subscale scores. As well, a significant difference was found on two of four Contingency subscale scores. Table 5 summarizes these findings.

Table 3. NCAFS Total and Subscale Score Means for Groups Over Age

	Group	7 to 9 Weeks	11 to 13 Weeks
Total	Intervention	64.6 (3.65)	60.9 (4.85)
	Control	57.4 (6.55)	56.8 (4.86)
Parent	Intervention	44.9 (2.55)	42.9 (2.32)
	Control	39.3 (5.92)	37.9 (2.85)
Contingency	Intervention	15.6 (1.13)	13.6 (2.00)
	Control	12.8 (2.66)	11.9 (2.17)

Note. Standard deviations in parentheses.

Table 4. NCATS Total and Subscale Score Means for Groups Over Age

	Group	7 to 9 Weeks	11 to 13 Weeks
Total	Intervention	51.6 (6.50)	55.1 (4.49)
	Control	46.5 (9.30)	46.4 (9.15)
Parent	Intervention	37.3 (4.82)	37.3 (4.52)
	Control	32.5 (6.63)	31.9 (6.29)
Contingency	Intervention	22.3 (3.30)	21.9 (2.36)
	Control	18.9 (5.06)	18.9 (3.76)

Note. Standard deviations in parentheses.

Cognitive Development and Visual Expectations

The groups were compared on the MDI with a Wilcoxin-Mann-Whitney test and found to be significantly different. The intervention group mean was 106 DQ points with a standard deviation 9.56 and the control group mean was 98.4 DQ points with a standard deviation 3.96 ($z = 2.01$, $p = .033$, $n = 15$). The effect size was 1.04.

Exploratory analyses were done on the three VEXP variables (postbaseline median RTs, percentage of anticipations, and percentage of fast RTs) despite lack of intrarater and interrater reliability in coding. However, the VEXP reliability was assumed to be the same for both groups because the coders were blind to group assignment. A significant difference was found for postbaseline median RT but not for percentage of anticipations (independent samples *t*-tests) or percentage of fast RTs (Wilcoxin-Mann-Whitney test). Infants in the intervention group reacted on average 204 ms faster to stimuli (approximately 6 frames difference, at 33 ms per frame) than infants in the control group ($t = 2.22$; CI $= -.402, -.006$; $p = .023$; $n = 15$). The effect size for the difference between groups on postbaseline median RT was 1.18.

DISCUSSION

The most obvious limitation of this study is sample size; only 13 of 24 subjects completed all of the intervention and outcome measurement. Further, the posttest-only design makes it impossible to eliminate the chance that group differences on

Table 5. Group Differences: Parent-Infant Interaction Total Scale and Subscale Scores

Dependent Variable		Intervention Mean	Control Mean	*t*	Confidence Interval	*p*	Effect Size
NCAFS 7-9 weeks	Total	64.6 (3.65)	57.4 (6.55)	2.57	1.16, 13.2	.012	1.36
	Parent	44.9 (2.55)	39.3 (5.92)	2.32	−.378, 10.8	.019	1.23
	Contingency	15.6 (1.13)	12.8 (2.66)	2.60	.476, 5.17	.011[a]	1.37
NCAFS 11-13 weeks	Parent	42.9 (2.32)	37.9 (2.85)	3.91	2.26, 7.75	.001	1.92
NCATS 11-13 weeks	Total	55.1 (4.49)	46.4 (9.15)	2.43	1.02, 16.48	.015	1.21
	Parent	37.3 (4.53)	31.9 (6.29)	1.96	−.501, 11.3	.035	1.72
	Child	17.9 (2.53)	14.5 (4.00)	2.02	−.215, 6.97	.032	.620
	Contingency	21.9 (2.36)	18.9 (3.76)	1.91	−.364, 6.36	.038	.897

Note. Standard deviations in parentheses. NCAFS, Nursing Child Assessment Feeding Scale; NACTS, Nursing Child Assessment Teaching Scale.
[a] Assumption of equality of variance violated.

the outcome variables were present at baseline. The added difficulty of obtaining reliable judgements of eye movements suggests that the VEXP technique, as used in this study, cannot be depended on to register true differences between groups, because of the inflated standard error of estimates (Cook & Campbell, 1979). Consequently, although promising, the results of this study lack generalizability.

Despite these limitations, some statements can be tentatively made about the effectiveness of the intervention. First, the *t*-tests and two-way ANOVA results (group effects) suggest promise in that group differences were observed in the overall quality of interaction, the parents' contributions to the interaction, and the proportion of contingently responsive parent-infant interactions. In particular, the group differences observed in the parents' scores suggests that the educational intervention program may have successfully targeted and influenced the parents' behavior in a positive way. However, the intensity of the intervention program may have given rise to these findings. In implementing the Keys to Caregiving program, the intervention program parents spent more time with the nurse-interventionist than the control group parents (30 minutes difference; Letourneau, 2000). Nonetheless, the data trends are similar to those reported by others (e.g., Loan, 1992; Leitch, 1996; Wendland-Carro, Piccinini, & Millar, 1999). On further examination, comparison of this study's results with the large NCAFS and NCATS datasets (Sumner & Spietz, 1994a, 1994b; Table 6) showed that, despite the intervention group means being consistently larger on the parent-infant interaction variables, the intervention and control group means for this study did not deviate outside of one standard deviation of the NCAFS and NCATS normed data on adolescents who were aged 13 to 19 years at the time they gave birth.

The nurse-interventionist's own experiences with the mothers and infants in their homes provide illumination of these findings. She observed that the parents in the intervention group asked questions that belied their developing sensitivity and responsiveness to their infants. For example, shortly after learning about infant states, many mothers then inquired about how to modulate infant states so that they could wake up their baby to play or breastfeed. The parents in the control group did not have the benefit of the systematic program, thus their questions were much less organized. The clinical importance of these experiential and experimental data remains to be seen.

Second, while the children's contributions to the overall quality of interaction were not significantly different between groups, the MDI and VEXP cognitive data suggest that the children's development may have been enhanced. However, because of this study's small sample size and the problem with the VEXP reliability, it cannot be ruled out that the difference was a consequence of chance or normal maturational development.

Despite limited reliability, the VEXP data, based on an experimental pilot technique, were consistent with the more conventional MDI data. This sug-

Table 6. Maximum Scores and Normed Data for Adolescent Mothers (13-19 years of age at birth): NCAFS and NCATS Scales

		Max	Mean	10th Percentile Cutoff
NCAFS				
n = 276	Total scale	76	57.97 (9.30)	44
	Parent subscale	50	38.50 (6.86)	29
	Child subscale	26	19.47 (3.65)	15
	Contingency subscale	18	13.03 (3.42)	9
NCATS				
n = 303	Total scale	73	53.27 (9.53)	40
	Parent subscale	50	38.23 (7.18)	29
	Child subscale	23	15.03 (4.55)	8
	Contingency subscale	32	21.14 (5.82)	13

Note. Standard deviations in parentheses. NCAFS, Nursing Child Assessment Feeding Scale; NCATS, Nursing Child Assessment Teaching Scale.
Data from Sumner & Spietz, 1994a, 1994b.

gests that the VEXP may be a promising approach for assessing infants' attentiveness and responsiveness and for examining the effects of interventions on the caregiving environment and early cognitive development. The difficulty of obtaining reliable judgements of eye movements suggests that the more objective scoring used by Haith and colleagues needs to be adapted to videotape technology. This can be done by isolating videotape frames on line with computer projection and localizing the center of the infant's pupil relative to markers in the X and Y planes. Such refinement will be undertaken in subsequent study.

Despite the small sample size and one case of low reliability of measurement, the results show promise. Across multiple sample sizes, observers, data coders, testing sessions, types of analysis, and instruments, significant differences between groups were found. Perhaps with more longitudinal study, the children's contributions to the improved interaction quality may become more apparent. Conclusions about the program's effectiveness must remain tentative until a full trial is completed. The next task will be to confirm these results in a full trial that could include longer-term follow-up as well as some socially relevant outcomes, such as the incidence of behavioral problems, school readiness, and peer competence.

In conclusion, this study offers tentative support for a nursing intervention program to improve parent-infant interactions and suggests changes in measurement that would enhance a full trial. Keys to Caregiving, a straightforward and readily useable parent-education program, may contribute to the quality of interactions between adolescents and their newborn infants and improve infant cognitive development. Nurses are well positioned to assist new adolescent mothers to develop sensitive and responsive interactions with their newborns in both hospital and community settings.

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